

Section	PDF page	EPA Slide	Comment Box	Specific Section of Slide
High-Priority Questions and Requests on EPA Slides – “Evaluation of Flow and Transport Hypotheses”	5	13	1	
High-Priority Questions and Requests on EPA Slides – “Evaluation of Flow and Transport Hypotheses”	5	13	1	
High-Priority Questions and Requests on EPA Slides – “Evaluation of Flow and Transport Hypotheses”	5	13	1	
High-Priority Questions and Requests on EPA Slides – “Evaluation of Flow and Transport Hypotheses”	6	25-28, 33, 34, 36	1	
High-Priority Questions and Requests on EPA Slides – “Evaluation of Flow and Transport Hypotheses”	7	39	1	
High-Priority Questions and Requests on EPA Slides – “Evaluation of Flow and Transport Hypotheses”	7	39, 40	2	
High-Priority Questions and Requests on EPA Slides – “Evaluation of Flow and Transport Hypotheses”	7	39, 40	2	
High-Priority Questions and Requests on EPA Slides – “Evaluation of Flow and Transport Hypotheses”	7	39, 40	2	
High-Priority Questions and Requests on EPA Slides – “Evaluation of Flow and Transport Hypotheses”	7	39, 40	2	
High-Priority Questions and Requests on EPA Slides – “Evaluation of Flow and Transport Hypotheses”	8	45-48	1	
High-Priority Questions and Requests on EPA Slides – “Evaluation of Flow and Transport Hypotheses”	8	45-48	1	
High-Priority Questions and Requests on EPA Slides – “Evaluation of Flow and Transport Hypotheses”	8	45-48	2	
High-Priority Questions and Requests on EPA Slides – “Evaluation of Flow and Transport Hypotheses”	8	45-48	2	
High-Priority Questions and Requests on EPA Slides – “Evaluation of Flow and Transport Hypotheses”	8	45-48	2	
High-Priority Questions and Requests on EPA Slides – “Evaluation of Flow and Transport Hypotheses”	9	45-48	1	
High-Priority Questions and Requests on EPA Slides – “Evaluation of Flow and Transport Hypotheses”	9	45-48	1	

Topic Area
Calibration
Calibration
Calibration
Calibration
Parameterization
Pumping
Pumping
Calibration
Pumping
Code / Inputs / Boundaries
Code / Inputs / Boundaries
Code / Inputs / Boundaries
Code / Inputs / Boundaries
Parameterization
Purpose / Inference
Purpose / Inference

Comment/Question
Please provide more explanation of the slide title: "Calibration weights may have unintended consequences for transient head fit and boundaries."
What are the numbers and arrows on the slide on right panel and how do are they associated with calibration weights?
From which document do these values come?
Please provide your 3-D geologic model (used to develop the flow model) or additional cross-sections and plan view indicating locations of cross-sections to better depict how these properties are represented in the model.
What were the parameter values for this model?
Where did you obtain the pumping data for the period of 2/28 to 3/14?
What were the stresses for RHS (pumping rate and length of pumping) for the transient simulation?
The observed data seem to be daily averages of the information at a more local time scale. Is this the case?
Was Red Hill Shaft pumping simulated at smaller than daily time steps during this period?
What model code was used for these simulations?
What flow options were used within the code? Specifically, confined/unconfined layers, wet/dry schemes, and vertical flow options.
What were the boundary and recharge fluxes?
Were the lateral boundary conditions kept fixed for this model, or were they resampled from the regional model with the same pumping stress applied?
What were the K-values of the three different material types for the different models? What was the drain conductance of Red Hill Shaft tunnel? How long did a local model generally take to run? How were the boundaries distributed?
Does EPA believe that these are viable models?
Are they more pertinent than those provided by the Navy?

<b>Brief Narrative Responses (As Discussed on the June 3rd Meeting)</b>
Emphasizing different components of the objective function appears to result in very different parameter and boundary estimates, suggesting poorly constrained estimates.
These numbers are from Rotzoll (2007) and indicate prior independent estimates of inter-basin flows.
From Rotzoll (2007). This has been provided with this response.
The 3D geologic model will be compiled and provided. As noted throughout these responses: this was developed for demonstration purposes and is not considered a final work product or opinion of the Agencies or its SMEs.
The 3D geologic model will be compiled and provided. As noted throughout these responses: this was developed for demonstration purposes and is not considered a final work product or opinion of the Agencies or its SMEs.
Pumping data were not used or available. RHS was represented as a drain, and the flows were constrained to be within anticipated ranges.
Pumping data were not used or available. RHS was represented as a drain, and the flows were constrained to be within anticipated ranges.
Yes
No
Versions of Modflow-USG and Modflow-6
Responses to these questions will be compiled and provided together with the 3D geologic model. As noted throughout these responses: this was developed for demonstration purposes and is not considered a final work product or opinion of the Agencies or its SMEs.
Boundary conditions and recharge were evaluated or estimated as part of the calibration process.
Boundary conditions and recharge were evaluated or estimated as part of the calibration process. Fluxes at the local boundaries could indeed be derived from the larger, Navy, models.
All parameters varied depending on the realization: typically, they varied by orders of magnitude (i.e., clinkers - 1000s, vesicular / fractured basalts 10's / dense interiors <1. The model took a few minutes to run. Fluxes at the local boundaries could indeed be derived from the larger, Navy, models.
The simulations were developed for demonstration purposes. They are not considered to be alternate or more pertinent CSMs, but to demonstrate methods for representing and evaluating key FEPs of the CSM.
The simulations were developed for demonstration purposes. They are not considered to be alternate or more pertinent CSMs, but to demonstrate methods for representing and evaluating key FEPs of the CSM.

High-Priority Questions and Requests on EPA Slides – “Evaluation of Flow and Transport Hypotheses”	9	45-48	1	
High-Priority Questions and Requests on EPA Slides – “Evaluation of Flow and Transport Hypotheses”	10	57	1	
High-Priority Questions and Requests on EPA Slides – “Evaluation of Flow and Transport Hypotheses”	10	57	1	
High-Priority Questions and Requests on EPA Slides – “Evaluation of Flow and Transport Hypotheses”	11	59	1	
High-Priority Questions and Requests on EPA Slides – “Evaluation of Flow and Transport Hypotheses”	11	59	1	
High-Priority Questions and Requests on EPA Slides – “Evaluation of Flow and Transport Hypotheses”	11	59	1	
High-Priority Questions and Requests on EPA Slides – “Evaluation of Flow and Transport Hypotheses”	11	59	1	
High-Priority Questions and Requests on EPA Slides – “Evaluation of Flow and Transport Hypotheses”	11	59	1	
High-Priority Questions and Requests on EPA Slides – “Evaluation of Flow and Transport Hypotheses”	11	59	1	
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	13	7	1	
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	14	9	1	Last sub- bullet
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	15	10	1	Right graph
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	16	14	1	
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	17	15	1	1st Bullet
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	18	16	1	

Purpose / Inference
Purpose / Inference
Purpose / Inference
Purpose / Inference
Parameterization
Purpose / Inference
Water Budgets / Mixing Calculations
Calibration
Multi-Model Analysis
Calibration
Calibration
Calibration
Mixing Calculations
Mixing Calculations

How do the results of the modeling effort change the risk management decision compared to those developed by the Navy?
Were the Agency SMEs able to answer the question about using targets vs. qualitative evaluation of sensitivities for the unit source contributions?
How do these unit source sensitivities compare to the mixing model(s) prepared by DOH?
Please provide all model simulations that you ran to better understand what modeling assumptions resulted in viable and non-viable model results, to improve the Navy's future modeling efforts.
Provide the base run parameters (i.e., horizontal anisotropy, recharge, vertical anisotropy in clinker)?
What were the criteria used to determine reasonableness of each of the four retained models? How many estimated models were run and discarded due to them not being reasonable?
Are the volumetric budgets and contribution to RHS correct for the Vertical Anisotropy in Clinker from Moanalua?
What is the basis for reducing horizontal anisotropy, increasing recharge (significantly above the USGS estimates), and reducing clinker Kz shown?
Do the Agencies believe that the complicated geologic and hydrogeologic conditions known to exist at Red Hill could be properly accounted for by one or two models? As previously discussed during TWG Meeting No. 22 (July 31, 2019), the Navy was going to evaluate criteria for reducing the models. What criteria have the Agencies considered that can be used to further reduce the suite of models?
What is the basis for stating that the suite of Navy models poorly represents migration patterns and rates from the tank farm to RHS? Specifically helpful would be the expected migration patterns and rates so the Navy can evaluate these models and potential additional modeling efforts against those expectations.
Please provide the data presented in the drawdown vs. time plot so the Navy understands which stress periods are represented.
Did the Agency SMEs prepare similar plots for other model pairs, and specifically the heterogeneous models (i.e., Models 53 and 54) since your focus is on heterogeneity?
Is this a reference to the chloride, nitrate, and $\delta^{15}\text{N}$ data presented in the DOH slides?
Were other sources of high chloride concentrations (e.g., Oily Waste Disposal Facility, Halawa Quarry, HDMW, Slop Oil facility) considered? If not, what was the reasoning for not considering those sources?

The simulations were developed for demonstration purposes. They are not considered to be alternate or more pertinent CSMs, but to demonstrate methods for representing and evaluating key FEPs of the CSM.
No. The simulations were developed for demonstration purposes. They are not considered to be alternate or more pertinent CSMs, but to demonstrate methods for representing and evaluating key FEPs of the CSM.
Example results from the unit source calculations were used to provide steady-state mixing proportions as a basis for demonstration calculations prepared by the DOH.
The simulations were developed for demonstration purposes. They are not considered to be alternate or more pertinent CSMs, but to demonstrate methods for representing and evaluating key FEPs of the CSM.
All parameters varied depending on the realization: typically, they varied by orders of magnitude (i.e., clinkers - 1000s, vesicular / fractured basalts 10's / dense interiors <1.
The simulations were developed for demonstration purposes. They are not considered to be alternate or more pertinent CSMs, but to demonstrate methods for representing and evaluating key FEPs of the CSM. Example results from the unit source calculations were used to provide steady-state mixing proportions as a basis for demonstration calculations prepared by the DOH.
They are consistent with the analyses as presented, but they do not represent an opinion of those values because the simulations were developed for demonstration purposes.
For sensitivity analysis as part of the hypothesis testing procedure.
The Agencies are hopeful that the multi-model development process can identify a small number of genuinely different geologic models (for example 2), with which alternate parameterizations and sensitivity analyses can be used. Thus, it is hoped that the number of structurally different models can be reduced from the current number, and uncertainty then evaluated through parameter variation within those models.
The primary basis for this statement is that the local calibration to groundwater elevations and to elevation differences has proven challenging.
These data will be compiled and provided. As noted throughout these responses: this was developed for demonstration purposes and is not considered a final work product or opinion of the Agencies or its SMEs.
No
Refer to DOH
Yes they were, although they were not simulated in these example calculations.



Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	18	16	1	
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	19	19	1	#1
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	19	19	1	#1
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	19	19	2	#2
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	19	19	3	#3
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	19	19	4	#4
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	20	20	1	1st Bullet
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	21	21	1	3rd Bullet
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	21	21	1	3rd Bullet
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	21	21	1	3rd Bullet
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	21	21	1	3rd Bullet
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	21	21	2	1st sub-bullet of 3rd bullet
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	22	22	1	1st, 3rd, 4th bullets

Water Budgets / Mixing Calculations
Miscellaneous
Miscellaneous
Water Budgets / Mixing Calculations
Parameterization
Miscellaneous
Parameterization
Code / Inputs / Boundaries
Code / Inputs / Boundaries
Code / Inputs / Boundaries
Code / Inputs / Boundaries
Code / Inputs / Boundaries
Parameterization

The Navy utilized various water budgets discussed in advance with the stakeholders, and their input/feedback was utilized in development of the model water budgets. What then was the basis for developing additional approaches?
Are the Agencies recommending more study of upwelling as a source?
Did the Agencies evaluate the frequently upward vertical gradient between the Halawa Deep Monitor Well and its chase tube?
Were mixing models developed for basalt compartment-alization examples?
Please explain the significance of this question to additional work and risk management decisions.
Have the Agency SMEs answered this question as a result of this work?
How did the Agency SME determine what is sufficiently complex? This would be important for the Navy to evaluate further modeling efforts.
The boundaries (lateral and vertical edges of domain and areal recharge) were developed in consultation with the Agency SMEs. What was the basis for changing these boundaries?
How could this be improved?
How do the CHBs and GHBs used in the small-scale model improve upon those agreed-upon boundaries? It is typically considered good modeling practice to move boundary conditions as far away from the localized area of concern as is practical.
Did the Agency SMEs use recharge values different than those presented by USGS (Engottet al. 2017)? If this is the source, were these average conditions (1977-2007), drought conditions (1998-2002), or current conditions (2001-2010)?
Please provide this other information and the specific boundary fluxes that were compared so they may be included in the Navy's analyses and appropriately referenced.
Please share with us that other information that helped you estimate parameters, flow, transmissivity, recharge, upwelling, and discharge proportions so they may be included in the Navy's analyses and appropriately referenced.

The simulations were developed for demonstration purposes. They are not considered to be alternate or more pertinent CSMs, but to demonstrate methods for representing and evaluating key FEPs of the CSM.
Not .
Not as part of this demonstration.
Not as part of this demonstration.
Clinker material is often interpreted as conductive to fluid movement; however, weathering of clinker at the water table could (a) result in a locally confined hydraulic response and (b) inhibit fluid migration vertically.
No
In this context, complex referred specifically to parameterization of basalt aquifer heterogeneity. A determination was not made as to whether the demonstration models were sufficiently complex .
The local scale of analysis, with local lateral boundaries, was developed to enable rapid simulation on a spatially refined grid exhibiting plausible heterogeneity. Fluxes at the local boundaries could indeed be derived from the larger, Navy, models.
The local scale of analysis, with local lateral boundaries, was developed to enable rapid simulation on a spatially refined grid exhibiting plausible heterogeneity. Fluxes at the local boundaries could indeed be derived from the larger, Navy, models.
The local scale of analysis, with local lateral boundaries, was developed to enable rapid simulation on a spatially refined grid exhibiting plausible heterogeneity. Fluxes at the local boundaries could indeed be derived from the larger, Navy, models.
Recharge was adjusted during sensitivity analyses during the demonstration simulations, and should not be incorporated into the Navy work .
Boundary fluxes were adjusted during sensitivity analyses during the demonstration simulations, and should not be incorporated into the Navy work. As noted throughout these responses: this was developed for demonstration purposes and is not considered a final work product or opinion of the Agencies or its SMEs.
All of the listed values and quantities were adjusted during sensitivity analyses during the demonstration simulations, and should not be incorporated into the Navy work. As noted throughout these responses: this was developed for demonstration purposes and is not considered a final work product or opinion of the Agencies or its SMEs.

Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	23	23	1	
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	24	25	1	
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	25	25-28	1	
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	26	30	1	
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	27	31	1	
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	27	31	1	
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	28	32	1	
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	29	41	1	
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	30	42-44	1	
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	30	42-44	2	
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	31	56	1	
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	32	58	1	
Remaining Questions and Requests on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	32	58	1	
Comments on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	40	7	1	5th Bullet

Water Budgets / Mixing Calculations
Pumping
Miscellaneous
Parameterization
Parameterization
Parameterization
Parameterization
Miscellaneous
Calibration
Calibration
Water Budgets / Mixing Calculations
Water Budgets / Mixing Calculations
Water Budgets / Mixing Calculations
Miscellaneous

Please explain why the Agencies “unit source” mixing model does not match observed groundwater geochemistry data (for various chemical constituents including Cl<sup>-</sup>).

Please detail how the pumping rates at Red Hill Shaft were applied to the drain boundary under steady and transient simulations.

Please provide model files (e.g., elevations of tops and bottoms of layers, boundary condition assumptions, hydraulic water budgets for each model, adjustable combination of CHDs & GHBs, etc.).

What is the basis for use of sand, loose rock and interflow voids in your geostatistical evaluation?

Please provide the data, geostatistical analysis and simulations used in your IK3D and SISM evaluations.

Please provide these graphic files and variogram adjustments so we can evaluate the methodology for possible use of the approach in the regional model.

Was there any accounting for the belief that the barrel logs overinterpret numbers and dimensions of lava tubes based on the techniques used to break the rock for tank installation?

Were some models able to represent the local “saddle” but not consistently so? If that is the case, please indicate what model conditions did allow the local “saddle” to be developed.

Localized head gradients between monitoring wells are expected to be different along Red Hill ridge due to localized heterogeneities. Slides 42 and 43 show observed and simulated three-point gradients that were determined to be acceptable. These slides indicate that angles differ by up to 35 degrees and magnitudes can differ by a factor of 2. The differences between observed and modeled “gradients” are as much as 145 degrees on slide 44. Please provide guidance on what SMEs would consider acceptable deviation.

Did you extend this analysis to all other monitoring wells and combinations not shown?

Why weren’t locally high chloride levels associated with the Oily Waste Disposal Facility and potential upwelling from Halawa Deep not considered as “unit sources”?

Were the Agency SMEs able to answer the question about putting bounds on influxes to provide proportions that respect independent information on water budgets?

What are those independent sources?

The Navy’s modeling indicates complete capture of these particles by pumping RHS at 4.65 mgd.

The simulations were developed for demonstration purposes. They are not considered to be alternate or more pertinent CSMs, but to demonstrate methods for representing and evaluating key FEPs of the CSM. Example results from the unit source calculations were used to provide steady-state mixing proportions as a basis for demonstration calculations prepared by the DOH.
Pumping data were not used or available. RHS was represented as a drain, and the flows were constrained to be within anticipated ranges.
The 3D geologic model will be compiled and provided. As noted throughout these responses: this was developed for demonstration purposes and is not considered a final work product or opinion of the Agencies or its SMEs.
They were not used in this work. The image shown and referred to is from early geostatistical work completed in 2018, that was not used directly in this work.
The 3D geologic model will be compiled and provided. As noted throughout these responses: this was developed for demonstration purposes and is not considered a final work product or opinion of the Agencies or its SMEs.
The 3D geologic model will be compiled and provided. As noted throughout these responses: this was developed for demonstration purposes and is not considered a final work product or opinion of the Agencies or its SMEs.
Yes. As a consequence, lava tubes were not represented in this work for demonstration purposes.
In the limited work that was undertaken for demonstration purposes, it was not possible to consistently represent the saddle.
The Agency SMEs have not developed quantitative measures of acceptability; comparisons made in the presentation and accompanying discussion on the June 3rd meeting were relative.
Yes.
Yes they were, although they were not simulated in these example calculations.
In the limited work that was undertaken for demonstration purposes, no attempt was made to bound the fluxes.
The independent information sources include Rotzoll (2007), and the Navy CSM and models.
The Agency SMEs find that this conclusion is not strongly supported by the local misfit between the models and measured data.



Comments on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	40	7	2	
Comments on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	41	9	1	1st Bullet and first two sub-bullets
Comments on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	41	9	2	4th sub-bullet of first bullet
Comments on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	42	10	1	Left scatter plots
Comments on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	42	10	2	Right graph
Comments on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	43	14	1	
Comments on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	44	16	1	
Comments on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	45	18	1	
Comments on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	46	21	1	2nd Bullet
Comments on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	47	35	1	2nd Bullet

Multi-Model Analysis
Parameterization
Multi-Model Analysis
Calibration
Calibration
Verification
Multi-Model Analysis
Multi-Model Analysis
Parameterization
Miscellaneous

The Navy's models have not been narrowed down to one or two models that are most appropriate for risk management decisions. The methodology described in the subsequent slides would result in many more non-unique models. This effort does not lead to one or two models most appropriate for a risk management decision.

The conceptual clinker model was only designed to evaluate the effects of a fast-flow path.

The Navy disagrees with the last bullet. The multimodel approach was developed based on input from the Agency SMEs (e.g., Top 10 Issues) to bound the range of expected flow conditions. While flow conditions may vary on a local basis, overall flow conditions from beneath the Facility to potential receptors and uncertainties associated with subsurface structure, parameterization and boundary conditions should be adequately represented by the various models presented in the GWFM report.

Please provide the data presented in the scatter plots and drawdown vs. time plot.

The Navy agrees that there are groupings of hydraulic responses at various wells. The Navy has maintained that wells such as RHMW07 do not behave similarly to other wells.

The Navy models were all calibrated to the same data and verified against the same data. Thus, all models represent the same data, and verification is intended to show that the same data are being represented by the models. If not, then those models would not be representative and therefore would be uncalibrated. Therefore, it is not clear what is meant by the statement that "Model verification doesn't differentiate the models' behaviors."

While the Navy agrees that "improved understanding of the water budget... leads to improvement...", the Navy used various water budgets discussed in advance with the stakeholders, and their input/feedback was used in development of the model water budgets. It would help to reduce the set of models if this is well understood, by performing zone budget evaluations of water crossing from Moanalua Valley in the regional models that have a different "southwest" boundary location from the SME's evaluations.

The resultant models seem to be only a few of many plausible explanations for the flow and solute distributions noted but are certainly non-unique.

Note that the Navy did develop heterogenous models (#53 and #54).

The Navy has been unable to locate information regarding the shot holes near the distal end of the water development tunnel other than those shown on the tunnel log.

The Agencies are hopeful that the multi-model development process can identify a small number of genuinely different geologic models (for example 2), with which alternate parameterizations and sensitivity analyses can be used. Thus, it is hoped that the number of structurally different models can be reduced from the current number, and uncertainty then evaluated through parameter variation within those models.

That is understood, and its representation provided useful insights that the other models did not.

While the Agency SME's agree it is possible that *"overall flow conditions from beneath the Facility to potential receptors and uncertainties associated with subsurface structure, parameterization and boundary conditions should be adequately represented by the various models presented in the GWFM report."* the local misfit between the models and the measured data does not strongly support this interpretation.

These data will be compiled and provided. As noted throughout these responses: this was developed for demonstration purposes and is not considered a final work product or opinion of the Agencies or its SMEs.

The Agency SMEs concur.

The Agency SMEs find that the degree of misfit is sufficiently large for all models for both the calibration data set and the verification data set that no conclusion regarding their individual or relative fitness for purpose can be reached.

The Agency SMEs agree that such calculations could be helpful, and it was one intent of the local-scale water budget and mixing calculations to assess whether such budget calculations could reduce the number of genuinely structurally different models.

The Agency SMEs agree that the results are not unique.

The Agency SMEs consider that the pilot point technique used in models #53 and #54 to infer and represent heterogeneity is an informative and valuable first step. However, the technique is prone to inferring heterogeneity in areas well beyond the area of primary interest, and is unlikely to be well suited to representing the types of structured heterogeneity present in the Oahu basalts on the scale of interest.

Thank you for the response.

Comments on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	48	41	1	
Comments on EPA Slides –“Evaluation of Flow and Transport Hypotheses”	49	59	1	

Miscellaneous
Water Budgets / Mixing Calculations

Indicates that the local grid model was unable to consistently represent this local "saddle." This is not entirely clear.

The mixing model described: (a) Is non-unique; and (b) assumes homogeneous conditions (e.g., constant  $Q_s$  and constant  $C_s$ ) to represent a highly heterogeneous condition. Local-scale heterogeneities may not affect regional flux from the Facility to receptors, but it can have a large impact on mixing computations.

In the limited work that was undertaken for demonstration purposes, it was not possible to consistently represent the saddle.

The Agency SMEs agree that the results are not unique, and that in the limited demonstration calculations some inputs (Q, C) were presumed constant, although this is not a limitation of the method.